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**Arroyo Center**

ARMY RESEARCH DIVISION

*Research Brief*

# Future Air and Missile Threats

Rarely has the U.S. Army had to worry about air attack. Since the early days of World War II, the Air Force and its predecessors have owned the skies, and the Army has been able to carry out its missions largely unimpeded by aerial threats. But that may change. A global economy promises to make technologies of all types widely available, which means that even sophisticated weapons will be cheaper and easier to get. These include not only the tactical ballistic missiles that menaced U.S. forces during the Gulf War, but also cruise missiles and armed unmanned aerial vehicles (UAVs). The long time it takes to develop and buy weapons forces the Army to start today to defend itself against the threats of tomorrow.

Researchers from RAND's Arroyo Center analyzed six plausible future worlds to determine which types of air and missile threats might confront the Army in a range of geopolitical or strategic situations with an eye to determining where it should invest its research and development funds. Results of the analysis appear in *Army Air and Missile Defenses: Future Challenges*.<sup>1</sup> Their major conclusions are that:

- The Army needs to invest more in cruise missile defenses
- The Army should retain and improve its short-range missile defense against aircraft
- Developing laser weapons against rockets and artillery may not be worth the cost
- Planned defenses against tactical ballistic missiles appear adequate in most cases.

## WHAT THE FUTURE MIGHT BRING

To paraphrase Yogi Berra, prediction is hard, especially about the future. To assist in solving this problem, the Arroyo researchers drew on other RAND work that characterized six plausible futures in 2025. These futures ranged from a chaotic world rife with anarchy to one that very much resembled today, with the United States as the

dominant power. These scenarios provided a way to illustrate how different geopolitical or strategic situations might shape air and missile defense requirements. For example, a world containing a major competitor might imply the potential for major war and increase the need to defend against tactical ballistic missiles.

## CRUISE MISSILES ARE PREVALENT

One of the study's major conclusions is that the threat of cruise missiles cuts across all scenarios. Although large numbers of cruise missiles or technologically sophisticated ones are likely to be present only in scenarios that include conventional conflict, unsophisticated versions based on UAVs could be present in small numbers in any scenario. The Army depends on airports to deploy, almost regardless of the type of scenario. Unsophisticated cruise missiles could be available to a wide spectrum of potential opponents, including drug lords and terrorists. They could use cruise missiles to hold airports or even densely populated cities at risk.

By way of illustrating the widespread nature of the cruise missile threat, the figure compares the scenarios in which an active defense is considered critical for cruise missiles and tactical ballistic missiles. The six scenarios are arrayed across the top and four defense requirements (the homeland, geopolitical assets, sustaining facilities, and forces) on the vertical axis. The shadowed boxes indicate that the threat is sufficient to require an active defense. Out of the 24 possible cases (6 scenarios x 4 needs), cruise missiles pose a threat in 16 compared with only 5 for tactical ballistic missiles.

Because cruise missiles and UAVs are universal threats, short-range air defenses will also be needed to defend against weapons that make it through the outer air defense layers. Where manned aircraft are likely to be present, short-range systems can degrade the enemy's ability to attack by forcing enemy ground attack aircraft to higher altitudes or by denying the enemy information gathered by UAVs. Artillery, rockets, and mortars were also present in all scenarios considered, and destroying them in the air would be desirable. But developing such a

<sup>1</sup>Frances Lussier, et al., *Army Air and Missile Defenses: Future Challenges*, Santa Monica, Calif.: RAND, DB-335-A, 2001.

capability might not be worth the investment if other approaches, such as counterbattery fire, can deal with these threats.

petitor emerges is the capability to defeat large and sustained barrage attacks of tactical ballistic missiles.

## WHERE TO INVEST?

Comparing current air defense capabilities with those postulated as necessary in the future shows the Army where it should invest its research and development funds. The Army should increase its emphasis on cruise missile defense because it will be needed whatever the world looks like in 20 years. To ensure effective defenses, the Army needs to develop a system that includes a sensor mounted on an aircraft or on a balloon that can detect low-altitude cruise missiles at long range. Assuming that naval systems could defend seaports, the Army should make its cruise missile defenses deployable so they will be available to protect airports crucial to the opening of a theater. Finally, to defend the United States or other large territories, effort should be invested in developing long-range interceptors so that cruise missile defenses can protect large areas with a reasonable number of launchers.

To defend against the wide variety of other threats likely in the future, the Army should develop complementary short-range systems. It needs to have a large number of short-range systems that can defend against manned aircraft. The Army should be cautious about investing in lasers. While they appear to have the potential to defeat some threats that missiles cannot—rockets, mortars—the technological risk is high and success depends on a breakthrough. As a hedge, the Army should improve the resistance of its short-range missiles to countermeasures.

The Army may want to wait until the future tactical ballistic missile threat is more sharply defined before stepping up its investment in defenses against such systems. If a peer or near-peer emerges, the Army will need effective interceptors and launchers that can fire enough rounds to counter barrage attacks. However, even if a peer does not emerge, the Army ought to enhance its anti-tactical ballistic missile systems by developing smaller and more efficient radar and generators so that its systems can deploy more easily. It also needs a system that can keep up with fast-paced operations.

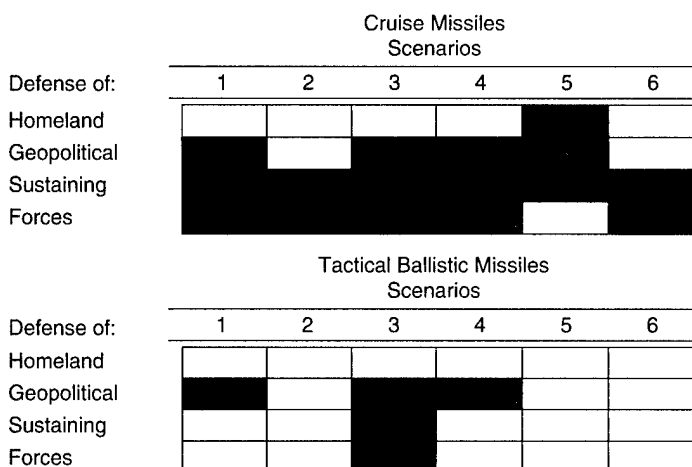


Figure 1—When Active Defenses Are Critical

## BUT TACTICAL BALLISTIC MISSILES ARE NOT

Iraqi Scud missiles garnered a lot of attention during the Gulf War. But Arroyo's analysis indicates that such missiles (or other versions) only pose a threat in conventional conflicts, and, as the figure shows, these are not likely in all scenarios. If the world evolves in such a way that a conventional conflict is not likely—the United States remains the sole superpower and democracy spreads worldwide (i.e., no rogue states), for example—the threat of tactical ballistic missiles is correspondingly low. However, until it becomes clear that the United States will not be involved in conflict with a rogue state or a peer competitor, it will need to defend against tactical ballistic missiles. Because no single system fielded by any of the services can defend all assets in theater from all likely threats, Army as well as Navy systems are needed early. Once Army antitactical ballistic missile systems arrive, they provide some unique capabilities. These include the ability to protect inland areas as well as an autonomous radar with robust detection and tracking capability. However, some additional capabilities would make the Army's systems more useful. One is the ability to accompany ground forces engaged in fast-paced maneuvers. The other capability that would be needed if a peer com-

RAND research briefs summarize research that has been more fully documented elsewhere. The research summarized in this brief was carried out in the RAND Arroyo Center; it is documented in *Army Air and Missile Defense: Future Challenges*, by Frances Lussier et al., DB-335-A, 2002, 74 pp., \$12.00, ISBN: 0-8330-2996-7, available from RAND Distribution Services (Telephone: toll free 877-584-8642; FAX: 310-451-6915; or Email: [order@rand.org](mailto:order@rand.org)). Abstracts of all RAND documents may be viewed on the World Wide Web (<http://www.rand.org>). Arroyo Center URL: <http://www.rand.org/ard/>. Publications are distributed to the trade by NBN. RAND® is a registered trademark. RAND is a nonprofit institution that helps improve policy and decisionmaking through research and analysis; its publications do not necessarily reflect the opinions or policies of its research sponsors.

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